

## **Generating Resources Advisory Committee January 27, 2015**

Meeting Time: 9:30 A.M. to 3:00 P.M  
Meeting Location: Northwest Power and Conservation Council  
Facilitators: Steven Simmons & Gillian Charles, NW Power & Conservation Council  
Note Taker: Amy Milshtein

### **Attendees on Site**

Gillian Charles	NWPCC
Steve Simmons	NWPCC
Jeff King	Consultant
Chris Colbert	NuScale Power
Lloyd Reed	GCPHA/Reed Consulting
Nate Sandvig	MWH Global
Duane Unland	Martinez Livestock Inc.
Daniel Martinez	Martinez Livestock Inc.
Mark Jones	BPA
Will Price	EWEB
Robert Petty	BPA
Rick Miller	HDR, Inc.
Steve Muchlinski	GCPHA/Muchlinski Consulting
Jim Gaston	Energy Northwest
Joe Eberhardt	EDF Renewable Energy
Tomas Morrissey	PNUCC
David Nightingale	WA UTC
Ehud Abadi	BPA
Kevin O'Meara	PPC
Fred Huette	NWEC
Brian Skeahan	Klickitat PUD JD Pool Project
Rick Sterling	Idaho PUC

### **Attendees via Go-To-Meeting**

Anna Kim	Seattle City Light
Bear Prairie	Idaho Falls Power
Anna Berg	Snohomish PUD
Brian DeKiep	NWPCC
Dave LeVee	Pwrcast
Elizabeth Osborne	NWPCC
James Gall	Avista
Luke Hansen	Northwestern Energy
Ian Hoag	PacifiCorp

Mike Hoffman	Pacific NW National Lab
Jan Lee	NW Hydro
Jeremy Eckstein	
Kathleen Newman	Oregon Renewables
Keith Knitter	Grant County PUD
Ken Miller	Snake River Alliance
Joe Klein	
Kurt Conger	Northern Wasco Co PUD
Larry Stene	BPA
Lisa Larson	HDR, Inc
Leann Bleakney	NWPCC
Megan Stratman	Northwest Requirements Utilities
Michael Manwaring	MWH
Brian Neff	California Energy Commission
Greg Nothstein	WA State Dept of Commerce
Pete Danko	
Phil Carver	Oregon Department of Energy
Robert Brown	PGE
Robin Rego	Energy Northwest
Russ Schneider	Flathead Electric Coop
William Saporito	Alstom Power
Brad Spangler	Snohomish PUD
Stefan Brown	PGE
Tom Haymaker	Clark PUD
Tom Karier	NWPCC
Zac Yanez	Snohomish PUD

Steve Simmons, NWPCC started the meeting and reviewed the agenda. Introductions were made and the role of the GRAC was reviewed.

Gillian Charles, NWPCC, asked for feedback in identifying regulatory compliance costs for existing plants. Jeff King, consultant, explained that the objective is to identify the financial and schedule effects of existing regulations.

Phil Carver, Oregon Department of Energy, asked if the Council is doing any analysis on any of the PacifiCorp plants that serve Oregon and Idaho loads. King answered yes, Bridger is included. Carver asked about Wyoming or Utah plants. King said no. Charles acknowledged that there was a request to look at other plants but that at the moment it isn't a high priority. Carver noted that PacifiCorp just posted detailed optimizer runs on their website that assume potential options for closures. Charles thanked him for the information.

Charles continued to review the December 18<sup>th</sup> GRAC Meeting, particularly updates regarding wind and transmission. Simmons and Charles introduced emerging technologies and reviewed how they are incorporated into Council analysis. Charles noted that the Council does not advocate one technology over another and that just because a resource is discussed does not necessarily mean it will be put into the Power Plan analysis.

The morning session consisted of multiple presentations from pumped storage experts. See the GRAC meeting page for the presentation materials - [http://www.nwcouncil.org/energy/grac/meetings/2015\\_01/](http://www.nwcouncil.org/energy/grac/meetings/2015_01/). The following notes focus more on the questions and discussion, rather than a synopsis of the presentation.

### **Pumped Hydro Storage**

#### **Rick Miller HDR**

Miller compared the physical size of a 20,000 MWh pump storage plant to a 20,000 MWh battery field [Slide 8]. David Nightingale, WA UTC, asked for the pond surface area for an equivalent sized project. Miller answered that it would be about a quarter of the size. Miller acknowledged that a battery project of that size would never be built as batteries are a distributed, substation application.

Fred Huette, NWECC, asks for clarification of +/- 8% on speed and 20% on power on the variability of advanced power electronics. Miller stated that the numbers are correct and explained.

Nightingale asked if Washington's discussion of a new system in the Columbia is part of Miller's work. Miller answered that they did look at those and represented them in the hydropower scoping study recently completed by the Council.

Simmons asked why so much pumped storage is on the East Coast. Miller answered that the pumped storage plants were envisioned to balance big coal and nuclear projects. Miller also noted the East's older grid with less flexibility.

Nightingale stated that the Northwest wind is limited in its dispersion as compared to California. Miller acknowledged the point.

Ehud Abadi, BPA, asked if the cost data Miller presented was for the West or Nationwide. Miller answered that they are not region specific, noting that the equipment costs are the same. Huette asked about planned and forced outage rates for the new systems. Miller answered that planned availability is 98% and forced outages are less than 0.5% in the first 20 years. Huette asked why so many permits were surrendered in the NW. Miller answered that there were a lot of site prospectors. Huette asked what discount rate was used for slide 29 Capital Cost Comparison. Miller did not know but will find out.

### **Banks Lake North Dam Pumped/Generation Plant**

#### **Lloyd Reed, GCPHA/Reed Consulting**

#### **Steve Muchlinski, GCPHA/Muchlinski Consulting**

Reed stated that he and Muchlinski are filling in for Tim Culbertson, manager, GCPHA.

Abadi asked if Reed knows the maximum project design flow (CFS) of Keys, for comparison to the 50,000 cited in this project. Lloyd guessed 15,-16,000 CFS and stated that there is 315 MW of generation. Mark Jones, BPA, stated that the number is slightly less, 14,000.

Charles asked if the 7-10 years of development time includes permitting. Reed answered yes.

Nightingale stated that considering the difficulties of the proposed long tunnels taking the shorter route to the open air canal makes more sense and asked about the obstacles to that approach. Reed answered that tapping into the Keys Canal would affect operations in the Keys Plant. Reed also noted that the canal would have to be doubled in size and that would disrupt its ability to supply irrigation. Lloyd states that despite this, it is still an alternative and might provide a way to share costs.

Miller explained the difficulties of expanding the channel in detail.

### **JD Pool Pumped Storage Project**

**Brian Skeahan, Klickitat PUD JD Pool Project**

**Nate Sandvig, MWH**

Skeahan encouraged the GRAC to look at the Argonne National Labs study which shows the value of a capital intensive, long lead time projects like pumped storage.

Carver asked about the choice to make the projects a dedicated, closed loop system. Miller asked if Skeahan would use the JD Pool as the lower reservoir for the project. Skeahan answered no, noting regulatory challenges.

Carver noted that there are not many downstream dams so the project would not contribute to mainstream flows. Miller stated that you want unconstrained operations and a closed loop system achieves that.

### **Value Stream of Pumped Storage**

**Miller, Skeahan, Sandvig**

Dave LeVee, Pwercast, asked about Smart Grid demand response activities that parallels what pumped storage can accomplish with shorter lead times and less capital, saying that it needs to be evaluated. Charles answered that the Council is looking at DR for the Seventh Plan. LeVee stated that he expanded the definition of DR to include customer loads.

Huette noted the value of pumped storage and stated that the problem with customer loads is getting to scale. He stated that advanced converts are coming but it will take years to get there as will battery

storage. He asked if it's better to look at a single 500 MW project or 100 5MW projects. He also noted that sub hourly modeling is in its early stages. Huette said that Skeahan is correct that trying to identify the entire value stream is important and is really hard.

Nightingale stated that storage fits into RPS but asked if it's not in the Plan then how BPA gets there. Charles answered that it will probably not make it into the RPM explicitly, but that it will be analyzed in the draft Seventh Plan and possibly make it into the action plan. Simmons added that they will look at needs and what emerging technologies may fill those requirements, but not necessarily in the same model.

Carver asked about compressed air energy storage. Miller noted some projects are in the works but noted that there has to be perfect geology.

Tom Haymaker, Clark PUD, mentioned economies of scale noting that the projects need multiple parties to succeed and wonders if the commercial/regulatory environment would allow multiple parties to come together. Skeahan answered that from his perspective it has to be on the table and he always saw these kind of projects with multiple participants. Haymaker stated his remaining skepticism. Carver mentioned that the Boardman to Hemingway Transmission Line has three partners. Simmons pointed to Miller's earlier analogy to gas storage with multiple owners. LeVee brought the groups attention to a past presentation where he explored the appropriate costs of capital for different projects noting that a low-cost, debt-financed approach is not the right perspective for this project.

### **Small Modular Reactors**

#### **Charles presented the background**

#### **Christopher Colbert, NuScale Power and Jim Gaston Energy Northwest**

Kevin O'Meara, PPC, asked about the purpose of the cooling towers shown on slide 8. Colbert answered that those towers are not for safety but for power generation.

Nightingale asked about the SCRAM procedure and noted that the rods are a failure point. Colbert acknowledged the point. Nightingale asked how the rods are inserted into the core if there is no power. Colbert answered that if the plant loses power either gravity or spring mechanisms will insert them.

Simmons asked where the manufacturing will take place. Colbert stated that it hasn't been picked yet but several locations are being considered.

Abadi asked, re slide 18, what percentage of the LCOE is fuel and what is capital. Colbert answered that 65% is capital, 10-15% fuel and the rest is variable and fixed O&M. He also stated that this is based on financing of 6.5%.

Colbert presented slide 19. Abadi asked what was built in the South Korea project. Colbert answered three loop machine pressurized water reactors (PWRs), typical Gen 2 reactor design.

Simmons mentioned future fuel costs and asked what Colbert predicted. Colbert stated that even a doubling of costs would not affect the LCOE. He noted that uranium has the same volatility of natural gas but is the smaller part of the overall cost of the operation.

King called the steam generation aspect the weak point of a traditional operation and wonders what aspects of this design are different. Colbert answered that in a typical PWR the primary coolant is going through the interior of the tubes while the boilant goes on secondary on the outside. This is a reverse where steam is produced inside the tubes which solve the failure rate. Also this is a natural flow instead of forced so the vibration is less. He notes that it remains a concern and there is a prototypical steam generator commissioned in a test facility to measure heat transfer and flow induced vibration. Finally he noted that the generator modules can be replaced one at a time if there is an issue.

Rick Sterling, Idaho PUD asked about waste. Colbert answered that this generates slightly more waste per MWh than a traditional plant but that they treat it in the same way as a traditional plant: wet storage, pad for dry cask storage and whatever is decided for long term.

Huette asked about the underground, underwater aspect of the project. Colbert returns to slide 6 and explains the layout stating that the module is brought out of its underwater bay and brought to a re-fueling area.

Huette asked how long the NRC will take to review the project. Colbert answered that it's 39 month review for a high quality application. Huette speculated early 2020 completion and asked for a breakdown of phases to actual commissioning and operations. Colbert answered that after the certification and 2-3 months later for UAMPS gets their license, it's a 28.5 month construction period with modules installed in months 30-45 to get to 2023/2024 installed and operating.

Huette noted that since Fukushima, the NRC might change some ground rules and wondered if these will affect these design basis. Colbert answered that the NRC is always evaluating safety cases and seismic input curves have changed. He stated that this project uses an acceleration rate of .5G and the Fukushima quake was a .4G. He further notes that this project eliminates many weaknesses associated with power loss. Huette asked if that means there can be no station blackout. Colbert stated that there can be a station blackout but not a core melt.

Nightingale asked about premature failure on the steam turbine and asked where it would be recovered and repaired. Colbert answered that it would depend on when it occurred and you might want to replace it but the rest of plant could operate. Nightingale asked that when you remove a module it's assumed that it's cold and safe. Colbert answered that the radiation would be within acceptable limits to move.

King noted that the development strategy would have no prototype. Colbert agreed stating that the first deployment would be a commercial deployment. He states they are comfortable with that because

most materials have been industry standard for years while the unique components (steam generator, control rods, and four critical valves) are being tested by a full site prototype.

Abadi asked about flexibility. Colbert stated that that's an economic question. He noted that it is easy to turn this off but then there is the problem of a high capital cost asset not being used. He then stated that the modular nature allows for rapid ramp up or down. Huette speculated that there might be more opportunity for cycling than traditional nuclear. Jim Gaston, Energy Northwest, shared that the Columbia Generating Station comes down from 100% to 85% easily. Gaston noted that this technology offers more opportunity for flexibility than that.

Nightingale asked what the levelized cost per dollar is if you use a dry system instead of a wet cooling tower. Colbert answered that the capital cost is unchanged and the output from the plant goes from 570MW down to 537MW. He states that he doesn't know how that translates to levelized cost but imagines that it would scale.

### **Energy Northwest Small Modular Reactor Update** **Jim Gaston, Energy Northwest**

Gaston presented an overview of the UAMPS SMR project in Idaho.

In response to Gaston's slide on legislation, Nightingale asked what other legislation is being pursued in Washington. Gaston answered that every state is interested in getting the production facilities so some Washington legislation proposes exempting them from sales tax. He says another institutes a nuclear education program in grades 6-10. A communication supporting the permanent repository noting that they can store for 60 years in dry casks but a permanent solution must be found. He then brings up the idea of reprocessing which was banned in the 1980s. He also mentioned included revising I-937 to include nuclear as a resource.

### **Enhanced Geothermal Systems** **Steven Simmons**

Simmons presented a preliminary look at the emerging technology of enhanced geothermal systems (EGS), also known as engineered geothermal systems.

Huette pointed out that while the process is similar to fracking it is called hydro shearing.

Will Price, EWEB, asked [re slide 16] if the hot dry rock recharges over time. Simmons answered yes but it takes a while to reheat. He noted that a fracture zone lasts 5-6 years and drilling is the most expensive part of the project.

Price asked if the technology can be used for load following. Huette said yes they don't need to operate in base load mode. Simmons agreed.

Huette asked about the location aspect [slide 9] and wondered if there are other potential projects on the way. Simmons stated that he is not aware of this kind of EGS anywhere but there are others.

Sterling asked about the short reservoir life for this kind of EGS. Simmons didn't know. King speculated that it has to do with introducing cold water and lack of water flow.

Sterling stated that because of the huge capital investment and exploration and development risk coupled with only lasting 6 years if successful makes this a hard sell. Simmons agreed and stated that this is what's spurring the technology development at Newberry to use the same well at different levels.

Simmons closed the meeting. Charles asked for feedback on the Environmental Methodology Cost of Compliance Table.